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| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
|---|---|---|---|---|
| 09/893,188 | 06/27/2001 | Bhanwar Singh | F0654 | 3906 |

23623 7590 05/19/2003

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| EXAMINER |
|---|
| UMEZ ERONINI, LYNETTE T |

| ART UNIT | PAPER NUMBER |
|---|---|
| 1765 | 7 |

DATE MAILED: 05/19/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

| Office Action Summary | Application No. | Applicant(s) |
|---|---|---|
| | 09/893,188 | SINGH ET AL. |
| | Examiner | Art Unit |
| | Lynette T. Umez-Eronini | 1765 |

*-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --*

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

1)☐ Responsive to communication(s) filed on _____ .

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

4)☒ Claim(s) 1-18 is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) 1-18 is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

**Application Papers**

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

**Priority under 35 U.S.C. §§ 119 and 120**

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

**Attachment(s)**

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

## DETAILED ACTION

### *Claim Objections*

1. Claim 17 is objected to because of the following informalities: "pre-determined amount," which refers to a process conducted prior to performing steps of the claimed invention. It is suggested that "predetermined" be deleted. Appropriate correction is required.

### *Claim Rejections - 35 USC § 112*

2. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

In claim 15, lines 9-10, "the irradiated portions of the positive tone photoresist layer are removed,"

in line 11, "the first patterned photoresist layer,"

in lines 13-14, "the patterned positive tone photoresist layer,"

in lines 18-19, "the non-irradiated portions,"

in lines 22-23, "the patterned negative tone photoresist layers,"

In claim 16, line 1-2, "the polymerized portions;"

In claim 17, in lines 2-3, "the second patterned photoresist;" and

In claim 18, "the second patterned photoresist layer" in line 3; lack antecedent basis.

***Claim Rejections - 35 USC § 102***

3. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

4. Claims 1, 4, 5, 6, and 7 are rejected under 35 U.S.C. 102(b) as being anticipated by Bartha et al. (US 5,635,337).

Bartha teaches, " . . . a method for producing a structure with more than two steps (multi-step structure) and ". . . such multi-step structures are formed inter alia in wiring planes of semiconductor chips and in the thin-film wiring of multilayer ceramic substrates . . ." (column 3, lines 46-49). "The substrate **1** . . . may consist of organic or inorganic material . . ." (column 3, lines 58-64) and the substrate may be " . . . for example, a dielectric substrate **1** . . ." (column 3, lines 49-51). Bartha further teaches, "The method for producing a substrate with a multi-step structure, comprising the steps:

producing a substrate;

depositing a first photoresist layer on top of the substrate;

forming a first opening in the photoresist layer;

depositing a further photoresist layer on top of the first photoresist layer;

forming a further opening in the further photoresist layer which is larger and overlays all of the opening in the first photoresist layer to build a multi-step opening structure in multiple photoresist layers;

then transferring the multi-step opening structure of the photoresist layers into the substrate to produce a similar multi-step opening structure in the substrate; and

in which the structure is transferred by simultaneously etching both the substrate and the previous photoresist layer to form the multi-step opening structure (claim 2).

The aforementioned reads on,

A method for making a dual damascene pattern in a single etch process comprising:

providing a wafer having at least one insulative layer formed thereon:

depositing a first photoresist layer over the at least one insulative layer;

patterning a first image into the first photoresist layer;

curing the first patterned photoresist layer;

depositing a second photoresist layer over the first patterned photoresist layer;

patterning a second image into the second photoresist layer; and

etching the at least one insulative layer through the first patterned photoresist layer and the second patterned photoresist layer simultaneously in the single etch process, wherein the first image and the second image are substantially formed in the at least one insulative layer, **as in claim 1**; and

wherein etching the at least one insulative layer through the first patterned photoresist layer and the second patterned photoresist layer further comprises

employing an etch chemistry that ablates an amount of the first patterned photoresist layer during the etching process without substantially affecting the second patterned photoresist layer, **as in claim 4**.

Since Bartha uses the same etching method in etching the same materials as that of the claimed invention, then using Bartha etching method would inherently result wherein the etch chemistry is highly selective to the first patterned photoresist layer and to the at least one insulative layer than to the second patterned photoresist layer, **as in claim 5**.

Bartha also teaches, " . . . removing the first photoresist layer **(2)** which it is not covered by the overlying second photoresist layer **(5)** and simultaneously removing the top-most photoresist layer **(5)**" (column 2, lines 6-9 and 34-37), which reads on,

removing the first patterned photoresist layer and the second patterned photoresist layer, **in claim 6**.

Bartha further teaches, "For multilayer ceramic substrates, a conventional positive working photoresist is employed, . . ." (column 4, lines18-19), which reads on,

wherein the first patterned photoresist layer is a positive tone photoresist layer, **as in claim 7**.

Since Bartha uses the same method of using a single etchant in etching the same material through the same types of photoresist as claimed in the present invention, then using Bartha's etching method would etch at least one insulative layer through the first patterned photoresist layer and the second patterned photoresist layer comprises employing an etch chemistry that would inherently ablate an amount of the

first patterned photoresist layer during the etching process without substantially affecting the second patterned photoresist layer, as in **claim 4**; and would result wherein the etch chemistry is highly selective to the first patterned photoresist layer and to the at least one insulative layer than to the second patterned photoresist layer, as **in claim 5**.

***Claim Rejections - 35 USC § 103***

5. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

6. Claims 2 and 3 are rejected under 35 U.S.C. 103(a) as being unpatentable over Bartha ('337) as applied to claim 1 above, and further in view of Chang (US 4,165,395).

Bartha differs in failing to teach irradiating the first patterned photoresist layer with ultraviolet light, **in claims 2 and 3**.

Chang teaches. " . . . said first resist is exposed to actinic radiation in the 2Å to 5000Å range . . ." (claim 4) and "It has been found that . . . ultraviolet radiation exposure of the lower resist yields a very low amount of scattering to provide a very high aspect ratio (column 5, lines 22-24) which reads on irradiating a first patterned photoresist layer with ultraviolet light.

It would have been obvious to one having ordinary skill in the art at the time of the claimed invention to modify Bartha by irradiating a photoresist with UV light as taught by

Chang for the purpose of providing a resist having a very low amount of scattering to provide a very high aspect ratio (Chang, column 5, lines 22-24).

7. Claim 8 is rejected under 35 U.S.C. 103(a) as being unpatentable over Bartha ('337) as applied to claim 1 above, and further in view of Dai (US 5,877,076).

Bartha differs in failing to teach the second patterned photoresist layer is a negative tone photoresist layer.

Dai teaches, " . . . forming dual damascene interconnections in semiconductor chips through the use of opposite type two-layered photoresist process. A silicon substrate is provided having a composite layer comprising a first layer of dielectric . . . Then, a layer of positive (P-type) chemical amplification resist (CAR) is deposited over the composite dielectric layer. . . . An opposite polarity, namely, a negative (N-type) CAR is next formed over the opposite P-type resist, and hole patterned through a clear field mask" (Abstract).

It is the examiner's position that it would have been obvious to one having ordinary skill in the art at the time of the claimed invention to modify Bartha by using a second patterned photoresist that is a negative tone photoresist layer for the purpose simplifying the state of known art of forming dual damascene structures (Dai, column 1, lines 30-33).

***Claim Rejections - 35 USC § 103***

8. Claims 9, 10, 11, 12, and 13 are rejected under 35 U.S.C. 103(a) as being unpatentable over Bartha ('337) in view Chang (US 4,165,395).

Bartha teaches, " . . . a method for producing a structure with more than two steps (multi-step structure) and " . . . such multi-step structures are formed inter alia in wiring planes of semiconductor chips and in the thin-film wiring of multilayer ceramic substrates . . ." (column 3, lines 46-49). "The substrate **1** . . . may consist of organic or inorganic material . . ." (column 3, lines 58-64) and the substrate may be " . . . for example, a dielectric substrate **1** . . ." (column 3, lines 49-51). Bartha further teaches, "The method for producing a substrate with a multi-step structure, comprising the steps:

producing a substrate;

depositing a first photoresist layer on top of the substrate;

forming a first opening in the photoresist layer;

depositing a further photoresist layer on top of the first photoresist layer;

forming a further opening in the further photoresist layer which is larger and overlays all of the opening in the first photoresist layer to build a multi-step opening structure in multiple photoresist layers;

then transferring the multi-step opening structure of the photoresist layers into the substrate to produce a similar multi-step opening structure in the substrate; and

in which the structure is transferred by simultaneously etching both the substrate and the previous photoresist layer to form the multi-step opening structure (claim 2).

The aforementioned reads on,

A method for making a dual damascene pattern using a dual layer patterning scheme and a single etch process comprising:

providing a wafer having at least one insulative layer formed thereon:

depositing a first photoresist layer over the at least one insulative layer;

patterning a first image into the first photoresist layer;

depositing a second photoresist layer on the first patterned photoresist layer;

patterning a second image into the second photoresist layer; and

etching the at least one insulative layer through the first patterned photoresist layer and the second patterned photoresist layer simultaneously in the single etch process, wherein the first image and the second image are substantially formed in the at least one insulative layer, **as in claim 9**.

Bartha also teaches, " . . . removing the first photoresist layer **(2)** which it is not covered by the overlying second photoresist layer **(5)** and simultaneously removing the top-most photoresist layer **(5)**" (column 2, lines 6-9 and 34-37), which reads on,

removing the first patterned photoresist layer and the second patterned photoresist layer, **in claim 9**.

Bartha differs in failing to teach irradiating the first patterned photoresist layer with ultraviolet light to stabilize the first patterned photoresist layer, in **claim 9**; and

wherein etching the at least one insulative layer through the first patterned photoresist layer and the second patterned photoresist layer further comprises

employing an etch chemistry that ablates an amount of the first patterned photoresist layer during the etching process without substantially affecting the second patterned photoresist layer, **in claim 10**.

Chang teaches. " . . . said first resist is exposed to actinic radiation in the 2Å to 5000Å range . . ." (claim 4) and "It has been found that . . . ultraviolet radiation exposure of the lower resist yields a very low amount of scattering to provide a very high aspect ratio (column 5, lines 22-24) which reads on irradiating a first patterned photoresist layer with ultraviolet light. Since Chang irradiates a photoresist with UV light as is claimed in the present invention, the using Chang method of irradiating a photoresist would result wherein irradiating the first patterned photoresist layer with ultraviolet light is for a time and at an energy dose sufficient to make the first patterned photoresist chemically resistant to organic solvents and developers, as in claim 10.

It would have been obvious to one having ordinary skill in the art at the time of the claimed invention to modify Bartha by irradiating a photoresist with UV light for the purpose of providing a resist having a very low amount of scattering to provide a very high aspect ratio (Chang, column 5, lines 22-24).

Bartha further teaches, "For multilayer ceramic substrates, a conventional positive working photoresist is employed, . . ." (column 4, lines18-19), which reads on,

wherein the first patterned photoresist layer is a positive tone photoresist layer, **as in claim 13**.

Since Bartha uses the same method of using a single etchant in etching the same material through the same types of photoresist as claimed in the present invention, then using Dai's method of etching would result wherein at least one insulative layer through the first patterned photoresist layer and the second patterned photoresist layer comprises employing an etch chemistry that would ablate an amount of the first patterned photoresist layer during the etching process without substantially affecting the second patterned photoresist layer, as in **claim 11**; and

wherein the etch chemistry is highly selective to the first patterned photoresist layer and to the at least one insulative layer than to the second patterned photoresist layer, **as in claim 12**.

9. Claim 14 is rejected under 35 U.S.C. 103(a) as being unpatentable over Bartha ('337) in view of Chang ('395) as applied to claim 9 above, and further in view of Dai ('076).

Bartha differs in failing to teach the second patterned photoresist layer is a negative tone photoresist layer.

Dai teaches, "A method is disclosed for forming dual damascene interconnections in semiconductor chips through the use of opposite type two-layered photoresist process. A silicon substrate is provided having a composite layer. . . Then, a layer of positive (P-type) chemical amplification resist (CAR) is deposited over the composite dielectric layer. . . . An opposite polarity, namely, a negative (N-type) CAR

is next formed over the opposite P-type resist, and hole patterned through a clear field mask" (Abstract).

It is the examiner's position that it would have been obvious to one having ordinary skill in the art at the time of the claimed invention to modify Bartha in view of Chang by using a second patterned photoresist that is a negative tone photoresist layer as taught by Dai for the purpose simplifying the state of known art of forming dual damascene structures (Dai, column 1, lines 30-33).

***Claim Rejections - 35 USC § 103***

10. Claims 15, 16, 17, and 18 are rejected under 35 U.S.C. 103(a) as being unpatentable over Bartha ('337) in view of Chang ('395).

Bartha teaches, " . . . a method for producing a structure with more than two steps (multi-step structure) and " . . . such multi-step structures are formed inter alia in wiring planes of semiconductor chips and in the thin-film wiring of multilayer ceramic substrates . . ." (column 3, lines 46-49). "The substrate **1** . . . may consist of organic or inorganic material . . ." (column 3, lines 58-64) and the substrate may be " . . . for example, a dielectric substrate **1** . . ." (column 3, lines 49-51). Bartha further teaches, "For multilayer ceramic substrates, a conventional positive working photoresist is employed, . . ." (column 4, lines18-19) and " . . . removing the first photoresist layer **(2)** which it is not covered by the overlying second photoresist layer **(5)** and simultaneously removing the top-most photoresist layer **(5)**" (column 2, lines 6-9 and 34-37). Bartha also teaches,

"The method for producing a substrate with a multi-step structure, comprising the steps:

producing a substrate;

depositing a first photoresist layer on top of the substrate;

forming a first opening in the photoresist layer;

depositing a further photoresist layer on top of the first photoresist layer;

forming a further opening in the further photoresist layer that is larger and overlays all of the opening in the first photoresist layer to build a multi-step opening structure in multiple photoresist layers;

then transferring the multi-step opening structure of the photoresist layers into the substrate to produce a similar multi-step opening structure in the substrate; and

in which the structure is transferred by simultaneously etching both the substrate and the previous photoresist layer to form the multi-step opening structure (claim 2).

The above aforementioned reads on,

A method for making a dual damascene pattern using a dual layer patterning scheme comprising:

providing a wafer having at least one insulative layer formed thereon:

depositing a positive tone photoresist layer over the at least one insulative layer;

patterning a first image into the positive tone photoresist layer;

depositing a second photoresist layer over the first patterned photoresist layer;

patterning a second image into the second photoresist layer;

etching the at least one insulative layer through the first patterned photoresist layer and the second patterned photoresist layer simultaneously in the single etch process, wherein the first image and the second image are substantially formed in the at least one insulative layer, **and**

removing the patterned positive tone, **as in claim 15**;

Bartha in view of Chang differs in failing to teach irradiating selected portions of the positive tone photoresist through a mask to effect an image-wise pattern transfer, wherein the irradiated portions of the positive tone photoresist layer are removed; polymerizing the first patterned photoresist layer using ultraviolet light radiation; irradiating selected portions of the negative tone photoresist through a mask to effect an image-wise pattern transfer, wherein the non-irradiated portions of the negative tone photoresist layer are removed; and removing the patterned positive and the patterned negative tone photoresist layers, **in claim 15**; and wherein the polymerized portions of the positive tone photoresist layer are chemically resistant to standard developer solutions and organic solvents, **in claim 16**.

Chang teaches. " . . . said first resist is exposed to actinic radiation in the 2Å to 5000Å range . . ." (claim 4) and "It has been found that . . . ultraviolet radiation exposure of the lower resist yields a very low amount of scattering to provide a very high aspect ratio (column 5, lines 22-24) which reads on irradiating selected portions of the positive tone photoresist layer through a mask to effect an image-wise pattern transfer, wherein the irradiated portions of the positive tone photoresist layer are removed. Since Chang irradiates a photoresist with UV light as is claimed in the present invention, then using

Chang's method of irradiating a photoresist would result in polymerizing the first patterned photoresist layer using ultraviolet light radiation and wherein the polymerized portions of the positive tone photoresist layer are chemically resistant to standard developer solutions and organic solvents, as in the present invention.

It would have been obvious to one having ordinary skill in the art at the time of the claimed invention to modify Bartha by irradiating a photoresist with UV light as taught by Chang for the purpose of providing a resist having a very low amount of scattering to provide a very high aspect ratio (Chang, column 5, lines 22-24).

Bartha in view of Chang differs in failing to teach removing the patterned positive tone and the patterned negative tone photoresist layers, **in claim 15**.

Dai teaches, "The next layer (**160**) is a negative N-type photoresist which is next formed over the previous, and of opposite polarity, P-type CAR (**150**) as shown in FIG. 3d " (column 6, lines 55-57) and removing said layers of photoresist (Claim 1).

It is the examiner's position that it would have been obvious to one having ordinary skill in the art at the time of the claimed invention to modify Bartha in view of Chang by using Dai method of removing the photoresist for the purpose of preventing structural defect from unwanted etched residues.

Bartha in view of Chang and Dai differs in failing to teach wherein etching the at least one insulative layer through the patterned negative tone photoresist layer and the second patterned photoresist layer further comprises employing an etch chemistry that

ablates a predetermined amount of the patterned positive tone photoresist layer during the etching process without substantially affecting the patterned negative tone photoresist layer, **in claim 17** and wherein the etch chemistry is highly selective to the first patterned photoresist layer and to the at least one insulative layer than to the second patterned photoresist layer, as **in claim 18**.

It is the examiner's position that the combination of Bartha's method of forming a multilayer structure, Chang's method of irradiating a photoresist with UV light, and Dai's method of forming a negative photoresist over a positive photoresist would have been obvious to one having ordinary skill in the art at the time of the claimed invention for the purpose of minimizing the steps in making a dual damascene structure.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Lynette T. Umez-Eronini whose telephone number is 703-306-9074. The examiner is normally unavailable on the First Friday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Benjamin Utech can be reached on 703-308-3836. The fax phone numbers for the organization where this application or proceeding is assigned are 703-972-9310 for regular communications and 703-972-9311 for After Final communications.

ltue
May 14, 2003

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